SPECIFICATION

# A MATERIAL OF LOW VOLUME RESISTIVITY, AN ALUMINUM NITRIDE SINTERED BODY AND A MEMBER USED FOR THE PRODUCTION OF SEMICONDUCTORS

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a ceramic material of low volume resistivity, and a member for the production of semiconductors using the material.

2. Related Art Statement

An electrostatic chuck system utilizing Johnson-Rahbek effect is useful for the adsorption and retention of semiconductor wafers. In such system, the volume resistivity of the substrate of the chuck may preferably be $10^8$ to $10^{13}$ Ω・cm for improved adsorption force and speed of response. It is therefore desirable to control the volume resistivity of the substrate within $10^8$ to $10^{13}$ Ω・cm in a temperature range intended for use, in the development of an electrostatic chuck.

For example, the applicant filed a Japanese patent publication (Kokai) with a laid-open number 315867/1997 and disclosed that the volume resistivity of aluminum nitride with a high purity may be adjusted to $10^8$ to $10^{13}$ Ω・cm at room temperature by adding a small amount of yttrium oxide thereto.

Japanese patent publication (Kokoku) with a publication number 46032/1988 discloses a process for producing an aluminum nitride sintered body. According to the claim 1, aluminum nitride powder containing 1 weight percent of oxygen is mixed with 0.01 to 15 weight percent of the oxide of a metal element selected among yttrium, lanthanum, praseodymium, niobium, samarium,

gadolinium and dysprosium to obtain mixed powder. The powder is then shaped and sintered to obtain an aluminum nitride sintered body having a high thermal conductivity and containing 0.01 to 20 weight percent of oxygen. According to "example 1" in the publication, aluminum nitride powder (with a mean particle diameter of 1 $\mu$m) containing 1 weight percent of oxygen is mixed with 3 weight percent of samarium oxide to obtain mixed powder. The powder is then subjected to hot press at a pressure of 300 kg/cm$^2$ and a temperature of 1800 ℃ for 1 hour to obtain a sintered body with a heat conductivity of 121 W・m/k at room temperature.

SUMMARY OF THE INVENTION

The effects of the addition of a rare earth element other than yttrium into an aluminum nitride sintered body on its volume resistivity was not studied, in the Japanese patent publication (Kokai) with a laid-open number 315867/1997. In the Japanese patent publication (Kokoku) with a publication number 46032/1988, a rare earth element is added to raw powder of aluminum nitride for improving the thermal conductivity of the resultant aluminum nitride sintered body. The effect of the addition on the volume resistivity of the sintered body was not studied.

An object of the invention is to provide a material, composed of an aluminum nitride sintered body, having a low volume resistivity of not higher than 1 $\times 10^{13}$ Ω・cm at room temperature.

Another object of the invention is to provide an aluminum nitride sintered body having a low resistivity at room temperature.

Still another object of the invention is to provide a member used for producing semiconductors, in which the volume resistivity may be controlled depending on the application, and to prevent the contamination of

semiconductors when the member is exposed to a corrosive gas.

The invention provides a material having a volume resistivity at room temperature of not higher than $1\times10^{13}$ Ω・cm (more preferably not higher than $1\times10^{12}$ Ω・cm). The material is composed of an aluminum nitride sintered body containing samarium in a converted content calculated as samarium oxide of not lower than 0.04 mole percent. The sintered body contains aluminum nitride phase and samarium-aluminum complex oxide phase.

The invention further provides an aluminum nitride sintered body containing samarium in a converted content calculated as samarium oxide of not lower than 0.04 mole percent. The sintered body contains aluminum nitride phase and $SmAl_{11}O_{18}$ phase.

The content of aluminum in the aluminum nitride sintered body should be enough for forming aluminum nitride particles as the main phase. The content may preferably be not lower than 35 weight percent, and more preferably be not lower than 50 weight percent, of the sintered body.

The inventors have found that the volume resistivity of an aluminum nitride sintered body at room temperature may be reduced to $1\times10^{13}$ Ω・cm or lower, by increasing the content of samarium as converted content calculated as the oxide to 0.04 mole percent or more and by forming aluminum nitride phase as well as samarium-aluminum complex oxide phase. Such effect of the addition of samarium on the reduction of the volume resistivity of an aluminum nitride sintered body has not been known.

Further, the inventors have studied an aluminum nitride sintered body with the reduced volume resistivity (especially the microstructure and composition) in detail. Then they found that the volume resistivity is